APPENDIX E REVIEW SUMMARY

E.1 METHOD IDENTIFICATION

The scope of the present NDM peer review is a NDM called “Loss of Room Cooling in PRA Modeling”. The NDM under review was developed by the PWROG and is documented in PWROG-18027-NP, Revision 0. *Loss of Room Cooling in PRA Modeling*. PA-RMSC-1391.

This method is a combination of two pre-existing methods. One method provides screening criteria for deciding whether HVAC equipment needs to be modeled as support systems of specific PRA equipment. There are two screening criteria, based on equipment survivability at 150F and 160F. These screening values are based on the extension of the Arrhenius method normally used to evaluate remaining qualified life for equipment exposed to high temperature.

When it cannot be demonstrated that room temperature does not exceed 150F or 160F, then the interference method can be used to generate a failure probability of the components in the room, as opposed to simply assume the equipment is failed.

The method that was peer reviewed merges the two methods above, providing additional considerations on applicability exceptions for specific components, provides improved technical basis for the higher screening threshold (i.e., 160F) and clarifies applications requirements for the interference method.

This peer review addresses only the NDM and not its implementation to a specific plant PRA. The scope of the NDM method being peer reviewed in this document addresses support system modeling and environmental conditions impacting component availability and reliability in PRA modeling, which are addressed in Part 2 of the PRA Standard. In particular, the System Analysis (SY) Technical Element (TE) will need to be re-peer reviewed in a dedicated focused-scope peer review if this method is implemented in a plant PRA relative to the following associated Supporting Requirements (SRs): SY-A3, SY-A6, SY-A11, SY-A18, SY-A21, SY-A22, SY-B6, SY-B9, SY-B11 and SY-B12. The method is intended to support Capability Category III of SY-A22.

The peer review was performed in February 2020, including a working meeting at the Westinghouse office in Rockville, MD, on February 18, 2020. Table E-1 provides the schedule for this peer review.

Table E-1: Detailed Review Schedule

Task	Date
Independent Team Training	February 6, 2020
Technical Material Available & Method Owner Kickoff Briefing	February 6, 2020
Off-site Review Prior to Onsite Review	February 6 to February 17, 2020
Onsite Review & Consensus Sessions	February 18, 2020

Table E-1: Detailed Review Schedule

Task	Date
Entry Brief and Process Overview	February 18 – 8:30am to 9:00pm
Method Review	February 18 – 9:00am to 2:00pm
Team Consensus	February 18 – 2:00pm to 4:00pm
Exit Brief	February 18 – 4:00pm to 5:00pm
Remote F&O Closure Assessment	March 20 to March 26, 2020
Team Consensus	March 26 – 1:00pm to 2:00pm

E.2 PEER REVIEW PROCESS

The NDM peer review was performed in accordance with NDM peer review guidance, including the F&O closure process, discussed in NEI 17-07 and the method was reviewed against the HLR and SRs presented in PWROG-19027-NP, Revision 1, "Newly Developed Method Requirements and Peer Review," December 2019.

E.3 PEER REVIEW TEAM

The NDM peer review was performed over a period of 2 weeks, starting from February 6, 2020. The reviewers familiarized themselves with the method and performed an initial review of the method remotely for 1 week, before a final review and consensus session that was conducted on February 18th 2020.

Because of the fact that this was the second review of this method, under slightly revised SRs, the relative simplicity of the method and the fact that the vast majority of the underlying data and supporting information were well established and used in previous PRAs, 1 week of offsite review was judged sufficient (as opposed to the 4 weeks of offsite review for a full-scope PRA peer review), and a team of two people was also judged to be sufficient.

The review was conducted by Dr. Andrea Maioli of Westinghouse and Mr. Mark Walz, from Ameren Missouri. Appendix D contains the resumes for the reviewers. The team was assembled by the peer review team lead. The lead and reviewer qualifications are summarized here below and are consistent with peer review requirements in the American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) PRA Standard and the guidelines of NEI 17-07 (see dedicated language on NDM peer review team member qualification).

It is noted that the method being peer reviewed, while addressing equipment qualification, does not rely on dedicated equipment qualification expertise but rather addresses the statistical methods used to model component reliability. This was within the field of expertise of the selected team.

Dr. Andrea Maioli, the team lead, has over 14 years of experience at Westinghouse in the nuclear safety area generally and PRA specifically for both existing and new nuclear power plants. He has supported and led peer reviews for internal events, internal flooding, fire PRAs, seismic PRAs, high winds and other external hazards. He is a member of the ASME/ANS Joint Committee on Nuclear Risk Management (JCNRM) and is the vice chair of the JCNRM Subcommittee on Standard Maintenance, which is maintaining the ASME/ANS PRA Standard. Dr. Maioli has experience in statistical methods and in modeling of equipment reliability and he has been the lead of numerous innovation activities within Westinghouse.

Mr. Mark Walz has over 39 years of experience in the nuclear risk industry in numerous aspects of PRA model development and risk-informed applications. He has supported numerous peer reviews on the internal events. He also has provided support and analysis for operational changes/problems and design modifications, including pump, piping, and valve hydraulic analysis and the determination of ASME code acceptability. He was directly involved in Equipment Qualification (EQ) analyses to remove HVAC requirements for PRA.

The same team was also used for the F&O closure.

Table E-2 shows the review assignments for each reviewer.

Table E-2: Reviewer Names and Responsibilities

Name	Organization	Onsite Review Meeting Participation	Role
Andrea Maioli	Westinghouse Electric Company, LLC	Onsite	Review Lead, Lead for NM-A, NM-B, NM-C and Support for NM-D, NM-E and NM-F
Mark Walz	Ameren	Onsite	Lead for NM-D, NM-E, NM-F and Support for NM-A, NM-B and NM-C

Consistent with the requirement in Section 1-6.2.2 of the ASME/ANS PRA Standard and with the draft NEI-17-07, the members of the peer review team were independent from the development of the method being peer reviewed. They were not involved in performing or directly supervising work on any element of the method under review.

E.4 METHOD CHARACTERIZATION AND TECHNICAL ADEQUACY ASSESSMENT

Table E-3 presents an overall summary of the results of the peer review.

Table E-3: Summary of Overall Results of the Method Review					
PRA Element	Number of Supporting Requirements Meeting Each Capability Category				
	Not Met	Met	N/A	Not Reviewed	Total
NM	0	18	3	0	21

Table E-4 provides a summary of the assessed attributes, along with the related F&Os for each attribute.

Table E-4: SR Assessment for the NDM Review		
Attribute	Assessment	Facts & Observations(1), (2)
NM – Newly Developed Method Assessment Technical Element		
NM-A1	Met	
NM-A2	Met	
NM-A3	Met	
NM-B1	Met	
NM-B2	N/A	
NM-B3	Met	
NM-B4	Met	
NM-C1	Met	
NM-C2	N/A	
NM-C3	Met	
NM-C4	N/A	
NM-C5	Met	
NM-C6	Met	
NM-D1	Met	
NM-D2	Met	
NM-D3	Met	
NM-E1	Met	
NM-E2	Met	
NM-E3	Met	

Table E-4: SR Assessment for the NDM Review		
Attribute	**Assessment**	**Facts & Observations[(1), (2)]**
NM-F1	Met	
NM-F2	Met	

Notes:

(1) Facts and Observations are identified as **FINDINGS** (in bold), SUGGESTIONS, and BEST PRACTICES (underlined). Note that F&Os may be linked to multiple SRs based on the issue and the specific requirements.

(2) F&O numbering is generated automatically from an Access database. If an F&O is deleted after being initially generated, this results in the numbering being non-sequential.

Table E-5 summarizes the number of open F&Os. There were no Unreviewed Analysis Method (UAM) findings.

Table E-5: Summary of Facts & Observations for the NDM Peer Review				
PRA Element	**Number of Supporting Requirements Meeting Each Capability Category**			
	Findings	**Suggestions**	**Best Practices**	**Total by Element**
NM	0	0	0	0

The key conclusions for the NDM peer review are discussed in the following subsections.

E.4.1 Method Characterization

The reviewed method is in actuality a process that incorporates two methods, used for a slightly different purpose. One is used for assessing the need to model HVAC systems as support systems in a PRA; and one is used to evaluate the probability of failure of equipment conditional on unavailability of HVAC (reflected explicitly in the PRA model) such that environmental conditions are beyond those stated in the equipment qualification.

In PWROG-18027-NP, the method developers performed a survey of PWROG members and concluded that the two individual methods that are discussed in PWROG-18027-NP essentially cover the majority of the surveyed plants (with a couple of exceptions). This would indicate that these two individual methods capture a good portion of the “state of practice”.

Independently, the two methods are not new and have been adopted in plant-specific PRAs that have undergone peer reviews. There is no discussion on whether specific F&Os were assigned to the PRAs that adopted those methods and whether the current work addresses those F&Os. While this is not critical, it would have provided a better context with respect with the “state of practice”.

Because of the above, it cannot be said that the overall method has either been developed separately from a state of practice or that it involves a fundamental change in the state of practice.

The overall method under review marginally meets the definition of NDM based on the loose definition of “state of practice” and on the fact that it has not gone through a dedicated method peer review.

E.4.2 Technical Adequacy

The method being reviewed adds a fair amount of technical justification to the two existing methods that have been blended together via a systematic review of limitations and applicability constraints based on expert judgment from equipment qualification experts. The developers of the methods also addressed the overlap between the two original methods, to ensure that they are compatible and consistent in the screening and modeling of the effects of loss of room cooling.

Two findings have been documented associated with the technical basis of the method. One addresses the fact that the method does not provide a clear threshold for applicability of the second screening criteria, which should be unequivocally capped at 160F. Any considerations above this temperature thresholds should be considered outside of this method.

The second finding challenges the criteria used to address correlation of equipment failures due to temperature increase. It is noted that this issue was already identified in the original peer review of the application of the interference method to a specific plant PRA. It would have been helpful to more explicitly address original F&Os assigned to each of the individual methods, as a way to facilitate the review of this newly developed method.

All F&Os (i.e., findings and suggestions) have been since addressed and are considered closed. Appendix C provides a list of the F&Os that were provided during the February 2020 peer review and their closure statements by the method development team and review team.

By meeting all the SRs in the NM TE, without any open F&O, this method is considered technically adequate for implementation in a plant PRA. A peer review of the implementation will be need by any plant that implements this method. The following SRs are to be included in the implementation peer review SY-A3, SY-A6, SY-A11, SY-A18, SY-A21, SY-A22, SY-B6, SY-B9, SY-B11 and SY-B12 and hazard-specific SRs that reference back to these SRs.